J. F. AUWAERTER

Character Set for 4-Row Teletypewriters

√7

October 4, 1961

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The attached memorandum contains the preliminary recommendation for a character set for Bell System 4-row teletypewriters.

All comments should be forwarded to J. B. Booth with copies to J. F. Auwaerter and A. L. Whitman no later than October 10, 1961.

J. B. Booth

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Character Set for 4-row Teletypewriters

October 4, 1961

Memorandum

The attached Table 1 contains the preliminary recommendation for a character set for Bell System 4-row teletypewriters. This code is identical with the current ASA X3.2 proposal with the exception of minor modifications suggested by IBM and the Bell System; the modifications have not been presented to the full committee for their concurrence.

In the opinion of the task force, the code represents a fair compromise between the conflicting requirements outlined in the September 13 meeting and is the code which has the best chance of gaining recognition as an international standard. Because of the necessities of compromise to achieve a standard, the final choice is not optimum in any area.

The code will permit the interchange of data between data processing systems and equipment with a minimum of translation but with a sacrifice of the most logical arrangement for data processing.

The keyboard which results from this code retains in their existing locations the alphanumerics and symbol keys which are normally touch-typed. There are numerous differences in the selection and location of the upper keytop symbols.

In accordance with available information on current European trends, the location of the alphanumerics in the code structure will facilitate negotiations for an international standard.

The code is not compatible with the Department of Defense standard code.

Code Levels

The code will specify only seven levels (B_0 through B_6). The new 4-row teletypewriters (page and tape) will generate and respond to (on start-stop basis) an 11 element* code consisting of a single unit start pulse, a two unit stop pulse and 8 intelligence units. When transmitting the new code the eighth level (B_7) could assume a mark (1) or space (0) condition. In transmission, the bits will be sent in the order B_0 through B_7.

Keyboard Arrangement

The keyboard arrangement which would result from the character set of Table 1 with a simple "bit-deletion" (conversion of B_4 from 1 to 0) is illustrated in Figure 1. Consideration is being given to a "bit-inversion" technique which would result in the keybaord arrangement illustrated in Figure 2; the latter having the advantage of positioning the diagonal (/) below the question mark (?), the hyphen (-) below the equals to (=), and enables the additional of the eight symbols to the K, L, M, N, O, P, comma and period keys. The disadvantage of the above is a slight increase in the cost of the keyboard.

*Element, unit, level, and bit are considered synonymous in this memorandum

Programming Symbols

The character set includes all of the Cobol symbols and five of the special Algol symbols i.e. ← ↑ \ [ ] . The symbols < and >, which are common to Cobol and Algol, are located in the 3rd octile (010 stick) not because of the necessity to collate low to the numerics and the alpha but because of the desire to retain these specific characters during a 7 bit to 6 bit collaspe or an expansion of the foreign alphabets. The graphics most susceptible to being displaced are the last four symbols in the 4th octile and the last five symbols in the 6th octile.

Up/Low Operation

The character set does not contain the lower case of the alphabet, but it does permit assigning the lower case to the 7th and 8th octiles - "Area of Planned Deviation."

In addition, two codes (UC and LC) have been assigned in the 2nd octile to permit, if it is found desirable, the up/low teletypewriter to operate with a mode shift.

Communication Controls

Only those controls which are expected to be used frequently are included in the basic set. Six positions have been left open for other future standard control codes or as a do-it-youself area. The entire two right hand sticks (octiles 7 and 8) can, in fact, be used for special (non-standard) codes.

Only the most frequently used of the assigned controls have been shown on the keytops in Figures 1 and 2.

Planned Deviations

Certain deviations from the standard character set will be permitted. The substitution of symbols in the basic code for special purposes will be permissible provided, however, that in any such deviation the symbols and alphanumeric characters retained shall also retain the code designation of the basic set.

Selective Calling

Additional research is required to establish the requirements for selective calling systems using the new code and in turn translate into specific requirements for the character set.

J. F. Auwaerter
J. B. Booth
A. L. Whitman

$B_3 B_2 B_1 B_0$	$B_6 B_5 B_4$ 000	001	010	011	100	101	110	111
0000	NULL	DATA DELIMITERS	b̸	0	!	P	ANS. BK.	
0001	RU		'	1	A	Q		
0010			"	2	B	R		
0011			<	3	C	S		
0100	WRU		>	4	D	T		
0101	MOTOR STOP		$	5	E	U	AREA OF PLANNED DEVIATION	AREA OF PLANNED DEVIATION
0110	V. TAB		%	6	F	V		
0111	H. TAB		&	7	G	W		
1000	FEEDOUT		(	8	H	X		
1001	TRANS. START		)	9	I	Y		
1010	BELL		* ②	+ ②	J	Z		
1011	REC. 1 ON		: ②	; ②	K	#		
1100	REC. 1 OFF	LF	/	?	L	@		
1101	REC. 2 OFF	CR	–	=	M	[①		
1110	REC. 2 ON	UC	,	←	N	] ①		ESCAPE
1111	TRANS. STOP	LC	.	↑	O	\ ①		RUBOUT

NOTE:

b̸ = SPACE

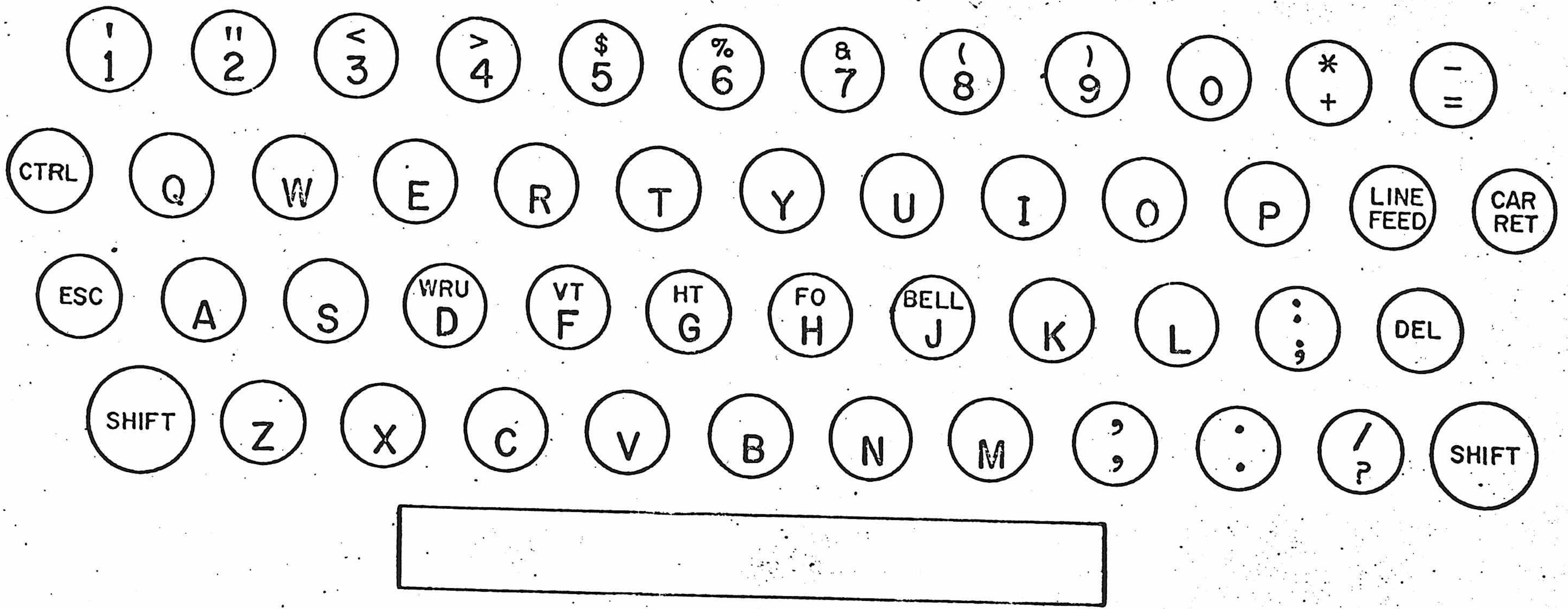
① IBM MODIFICATION

② BELL SYSTEM MODIFICATION

CHARACTER SET FOR
BELL SYSTEM 4-ROW
TELETYPEWRITER

(PRELIMINARY RECOMMENDATION)

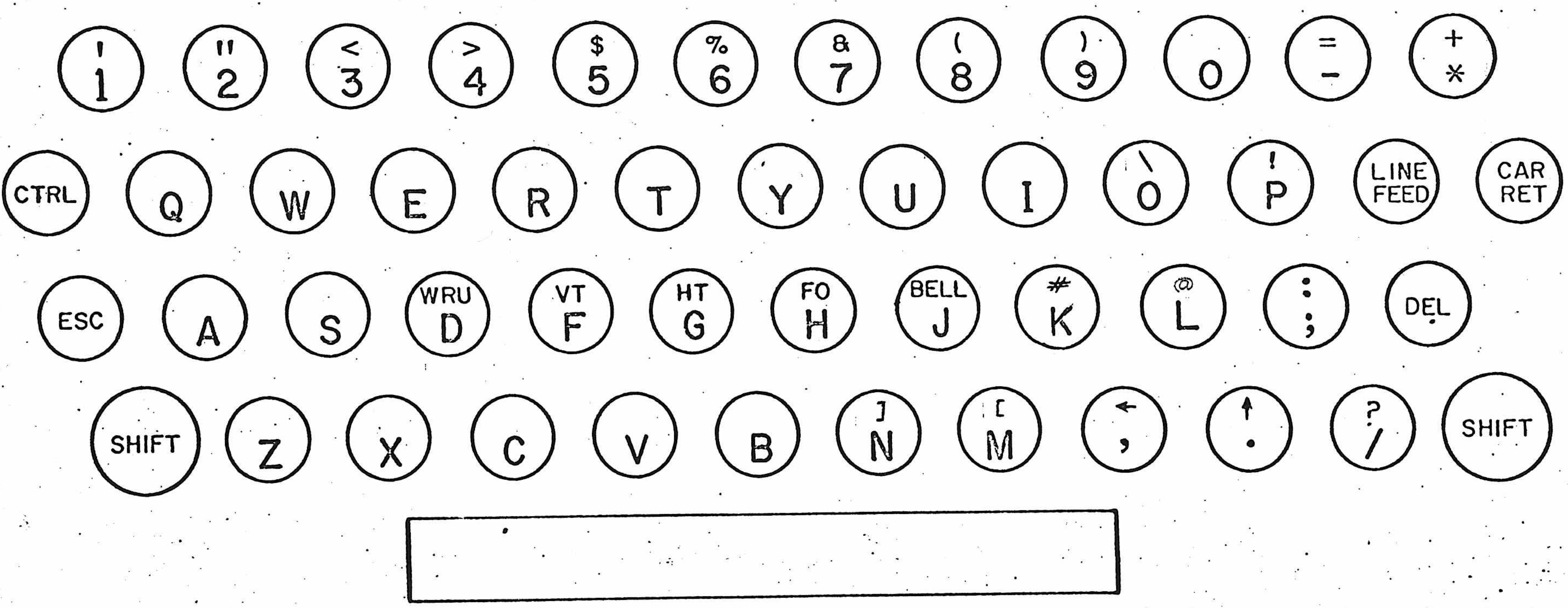
JEB 10/3/61



KEYBOARD ARRANGEMENT
FOR 4-ROW TELETYPEWRITER
(BIT-DELETION)
(PRELIMINARY RECOMMENDATION)

FIGURE 1

JFA 10/4/61



KEYBOARD ARRANGEMENT
FOR 4-ROW TELETYPEWRITER
(BIT-INVERSION)
(PRELIMINARY RECOMMENDATION)

JFA 10/4/61

FIGURE 2

GPO

ENGINEERING DEPARTMENT
2 - 12, Gresham Street, LONDON, E.C.2

Telex: 21266 (PO ENGCHIEF LDN)

In any reply please quote: Tg1/RNR
Your reference:

Telegraph *Branch*
Tel. HEAdquarters 4157

11th October, 1961

Dear Sir,

As Mr. Rhodes is at present in Geneva for the C.C.I.T.T. meeting on Data Transmission, I am replying on his behalf to your letter dated September 11th (supplemented by your communication of October 2nd). Before his departure Mr. Rhodes studied your letter with interest and the following reply represents his views on the points you have raised.

The C.C.I.T.T. has already considered this question of a new telegraph alphabet, for which a special meeting was convened in Warsaw in May 1958. The proposed line of study had the twofold object of an expanded telegraph alphabet (1) for the inclusion of diacritical signs and additional characters required in some languages and (2) to cater for the needs of data processing. In reply to a questionnaire the views of the U.S. Carriers were in general agreement with those of other Operating Agencies and Administrations that it was premature at that time to standardise a new telegraph alphabet. At the New Delhi Plenary Assembly (December 1960), an

/agreement

10/16*

Mr. J. F. Auwaerter,
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Teletype Corporation,
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NMAH 310/2

agreement was reached to the establishment of a special Working Party to study this question of a new telegraph alphabet. No date has yet been fixed for the first meeting of this Working Party and as the C.C.I.T.T. regards this as a forward-looking question, it seems most unlikely that any early progress will be made in this matter.

Replying now to the five questions posed in the ultimate page of your letter :-

(1) We agree that the same factors apply in Europe, and that if a new telegraph alphabet is introduced it would be preferable that it should serve the needs both of computers and communications. There are obvious advantages in obtaining as nearly as possible a common keyboard layout for typewriters and teleprinters, and in the consequent elimination of "figure shift" and "letter shift" in their present teleprinter form.

(2) We would accept the need for some compromise to achieve a common alphabet. In particular we think it would be unwise to restrict development by endeavouring to achieve compatibility with the existing telegraph alphabet.

(3) We agree that a logical build-up of the code is a desirable principle, but there are many ways in which this can be achieved. British computer manufacturers have been considering this in some detail, and the British Standards Institution has produced a draft specification for 5,6,7 and 8-unit codes, which will form the basis of a U.K. contribution to the International Standards Organization. It is understood that copies of this draft specification have been sent to the Teletype Corporation. These alphabets differ considerably from any of those put forward in your present proposals.

(4) At present the C.C.I.T.T. appears to be thinking in terms of a 6-unit code. If this were to be adopted it

/would

would be necessary for the control combinations to be included within the alphabet, and a "dense sub-set" would not be practicable. From a telegraph point of view a 6-unit code would probably be adequate, and it might be possible to accommodate it in the present European telegraph transmission network without any decrease in word speed. It is, however, desirable that communication channels should be capable of transmitting 7 and 8 information-bit codes, and in this connection the avoidance of simulated clearing signals has to be borne in mind.

(5) It is our view that 50-baud modulation will continue in Europe for many years. As I said in my reply to Question 4, the network which has been designed for 50 bauds would probably accept 6-unit start-stop signals without reduction in word speed (i.e. 57 bauds with 8.5 units in 150 milliseconds), but any further increase in the number of bits per character would involve a reduction in traffic speed.

Yours truly,

Renton.

(R. N. RENTON)

R Bemer

Appendix B - CIRCA 1961 OCTOBER

Related Subsets, Extensions and Deviations

B1. Introduction

B1.1 It is self evident that a single coded character set will not completely satisfy the requirements in all applications to specific problems. In certain specific cases it will be desirable , if not economically mandatory, that a code other than the standard be employed. In these cases, the code should be so related to the standard as to require minimal translation or transformation when information interchange involving the standard code is necessary.

A number of points are covered in this paper which should be of considerable assistance when dealing with this problem. This report is by no means exhaustive, but should be a suitable guide.

B2. Character Substitution

B2.1 Within a given set size, a code may be assigned more than one graphic and/or control function. However, no graphic or control function should be represented by more than one code.

It is preferable that substitutions be confined to a single class of character, e.g. should a code be used for a graphic function, any substitution should be another graphic. Any substitution involving a control should be done only with full cognizance of all possible system effects.

B3. Reserved (undefined) areas

B3.1 Two areas are reserved in the first (000) column and one code is reserved in the last column (111) for additional (undefined) controls.

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B4. Planned Deviations in 7-Bit Set

B4.1 As illustrated in Fig. B1, there are four areas in the standard set in which there are planned deviations. In the countries in which the Sterling Monetary System is used, the dollar sign $ will be replaced with the pound sterling £ , and the arrows pointing upward ↑ and to the left ←, will be replaced with the digits 10 and 11 respectively.

The five graphics which follow the alphabet in column 5, may be removed to allow for the expansion to European alphabets. In most cases, three additional letters will be required.

The lower case alphabet, when required in a 7-Bit set, will be placed in the last two columns (110 and 111) in positions which correspond to the respective upper case letters in columns 100 and 101.

Additional deviations, such as the inclusion of the Greek or other alphabets, may be defined, pending further investigation of the 8-Bit set.

B5. Transformed Sets

B5.1 Consideration has been given to collapsing the standard set into smaller (6-Bit and 4-Bit) sets, and to the possible expansion to an 8-Bit set. Examples shown in Fig. B2 and Fig. B3 illustrate possible 6-Bit and 4-Bit transforms. Fig. B4 illustrates a possible 8-Bit set related to the standard set. None of the transformed sets should be considered as being standard.

Lower Case Alphabet

NULL	R1 ON	ƀ	0	!	P		p
SOM	R2 ON	'	1	A	Q	a	q
MOFF	X ON	"	2	B	R	b	r
RU	EOA	<	3	C	S	c	s
WRU	R1 OF	>	4	D	T	d	t
EOT	R2 OF	$	5	E	U	e	u
H TAB	X OFF	%	6	F	V	f	v
FF	EOM	&	7	G	W	g	w
V TAB	DD	(	8	H	X	h	x
①	DD	)	9	I	Y	i	y
BELL	DD	•	↑	J	Z	j	z
①	DD	,	←	K	@	k	①
CR	DD	*	+	L	\	l	ACK
LF	DD	:	;	M	[	m	①
UC	DD	—	=	N	]	n	ESC
LC	DD	/	?	⊙	#	o	DEL

European Alphabet

NULL	R1 ON	ƀ	0	!	P	↑	↑
SOM	R2 ON	'	1	A	Q		U
MOFF	X ON	"	2	B	R		N
RU	EOA	<	3	C	S	U	A
WRU	R1 OF	>	4	D	T	N	S
EOT	R2 OF	£	5	E	U	A	S
H TAB	X OFF	%	6	F	V	S	I
FF	EOM	&	7	G	W	S	G
V TAB	DD	(	8	H	X	I	N
①	DD	)	9	I	Y	G	E
BELL	DD	•	10	J	Z	N	D
①	DD	,	11	K	Å	E	↓
CR	DD	*	+	L	Ä	D	ACK
LF	DD	:	;	M	Ö	↓	①
UC	DD	—	=	N	]		ESC
LC	DD	/	?	⊙	#		DEL

① – Unassigned Controls
DD – Reserved for Data Delimiters

PLANNED DEVIATIONS

FIG. B1

Dense Graphic

ƀ	0	!	P
'	1	A	Q
"	2	B	R
<	3	C	S
>	4	D	T
$	5	E	U
%	6	F	V
&	7	G	W
(	8	H	X
)	9	I	Y
•	↑	J	Z
,	←	K	@
*	+	L	\
:	;	M	[
—	=	N	]
/	?	O	#

Escape (to Control)

ƀ	0	!	P
'	1	A	Q
"	2	B	R
<	3	C	S
>	4	D	T
$	5	E	U
%	6	F	V
&	7	G	W
(	8	H	X
)	9	I	Y
•	↑	J	Z
,	←	K	@
*	+	L	\
:	;	M	[
—	=	N	ESC
/	?	O	#

Set with Delimiters Alternate Binary Seq.

ƀ	!	P	0
'	A	Q	1
"	B	R	2
<	C	S	3
>	D	T	4
$	E	U	5
%	F	V	6
&	G	W	7
(	H	X	8
)	I	Y	9
•	J	Z	↑
,	K	DD	←
*	L	DD	+
:	M	DD	;
—	N	DD	ESC
/	O	DD	DEL

Limited Function Teleprinter Set

ƀ	0	!	P
'	1	A	Q
"	2	B	R
<	3	C	S
>	4	D	T
$	5	E	U
%	6	F	V
&	7	G	W
(	8	H	X
)	9	I	Y
•	↑	J	Z
,	←	K	@
CR	+	L	\
LF	;	M	[
—	=	N	ESC
/	?	O	DEL

6 BITS

EXAMPLES OF POSSIBLE TRANSFORMED SETS

FIG. B2

Dense Graphic	Sterling	Escape
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9
.	10	↑
,	11	←
+	+	+
◇	◇	◇
−	−	ESC
/	/	DEL

4 BITS

EXAMPLES OF POSSIBLE TRANSFORMED SET

FIG. B3

	00				01				10				11			
	00	01	10	11	00	01	10	11	00	01	10	11	00	01	10	11
0000	WS	|	∧	¬	α	σ	↑	0		P		p	NULL	R1 ON	↑	↑
01	'	¶	∨		β	τ	D	1	A	Q	a	q	SOM	R2 ON		U
10	"	§	⊻	≡	γ	υ	O	2	B	R	b	r	M OFF	X ON		N
11			<	≥	δ	ϕ	I	3	C	S	c	s	RU	EOA	U	A
0100			>	≤	ε	χ	T	4	D	T	d	t	WRU	R1 OF	N	S
01		¢	$	£	ζ	ψ	Y	5	E	U	e	u	EOT	R2 OF	A	S
10			%	°	η	ω	OU	6	F	V	f	v	H TAB	X OFF	S	I
11			&		θ	Γ	RS	7	G	W	g	w	FF	EOM	S	G
1000	(		{	↓	ι	Δ	EL	8	H	X	h	x	V TAB	DD	I	N
01	)	¤	}	→	κ	⊖	F	9	I	Y	i	y	①	DD	G	E
10	.	†	↔	↑	λ	≡		∧	J	Z	j	z	BELL	DD	N	D
11	,	‡	@	←	μ	Π	GR	>	K		k		①	DD	E	↓
1100	*	☆	\	+	ν	Σ	APH	✚	L		l		CR	DD	D	ACK
01	:	;	[	×	ξ	I	IC	●	M		m		LF	DD	↓	①
10	–	C_R	]	=	π	Ψ	S	▭	N		n		UC	DD		ESC
11	/	?	#	|	ρ	Ω	↓	÷	O		o		LC	DD		DEL

EXAMPLE OF POSSIBLE 8 BIT SET
RELATED TO 7 BIT STD.

FIG. B4

October 23, 1961

6.5
17
23.50

TO MEMBERS OF X3-2

Attached are the first drafts to sections of the Final Report. Drafts of the remaining sections will be mailed as soon as they are received.

The meeting has been firmly established for November 8th, 9th and 10th at the B.E.M.A. Headquarters in New York City.

Based on the attached drafts it appears very possible we should be able to complete the final in early November. Looking forward to seeing you in New York.

Best regards,

C E Macon

C. E. Macon
Chairman X3-2

CEM:aks

Attch: Data Manipulation Considerations
ASA X3.2 Subcommittee Proposed
Coded Character Set

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ASA X3.2 SUBCOMMITTEE
Recommended Coded Character Set

	0	1	2	3	4	5	6	7	
	0000000	0010000	0100000	0110000	1000000	1010000	1100000	1110000	
	$B_6B_5B_4B_3B_2B_1B_0$							$B_6B_5B_4B_3B_2B_1B_0$	
1	NULL	↑ 8 Data Delimiters ↓	SP	0	↑	P	ANS.BK.		0000
2	RU		▽	1	A	Q			0001
3			▽▽	2	B	R			0010
4			<	3	C	S			0011
5	WRU		>	4	D	T			0100
6	MTR. STP.		$	5	E	U			0101
7	V. Tab		%	6	F	V			0110
8	H. Tab		&	7	G	W			0111
9	F. Out.		(	8	H	X			1000
10	Xtr. Str.		)	9	I	Y			1001
11	Bell		:	;	J	Z			1010
12	R.1 on		*	+	K	#			1011
13	R.1. Off	LF	/	?	L	@			1100
14	R.2 off	CR	-	=	M	[			1101
15	R.2 on	UC	,	÷	N	]			1110
16	Xtr. Stp.	LC	.	4	O	\		Esc. Del.	1111
	0001111	0011111	0101111	0111111	1001111	1011111	1101111	1111111	
	Control		Data Information subset				Unassigned (except as shown)		

CHART II

2	3	4	5
0100000	0110000	1000000	1010000
$B_6B_5B_4B_3B_2B_1B_0$	$B_6B_5B_4B_3B_2B_1B_0$	$B_6B_5B_4B_3B_2B_1B_0$	$B_6B_5B_4B_3B_2B_1B_0$
SP	0	!	P
'	1	A	Q
"	2	B	R
<	3	C	S
>	4	D	T
$	5	E	U
%	6	F	V
&	7	G	W
(	8	H	X
)	9	I	Y
:	;	J	Z
*	+	K	#
/	?	L	@
-	=	M	[
,	←	N	]
.	↑	O	\
0101111	0111111	1001111	1011111

INFORMATION SUBSET of 7 Bit set

0 00000	0 10000	1 00000	1 10000
B_6 $B_4B_3B_2B_1B_0$	B_6 $B_4B_3B_2B_1B_0$	B_6 $B_4B_3B_2B_1B_0$	B_6 $B_4B_3B_2B_1B_0$
SP	0	!	P
'	1	A	Q
"	2	B	R
<	3	C	S
>	4	D	T
$	5	E	U
%	6	F	V
&	7	G	W
(	8	H	X
)	9	I	Y
:	;	J	Z
*	+	K	#
/	?	L	@
-	=	M	[
,	←	N	]
.	↑	O	\
0 01111	0 11111	1 01111	1 11111

Transformation to 6 Bit Set.

CHART III

TABLE I

Character Abbreviations and Definitions

CONTROL CHARACTERS

Null	No information--can use as "transmission break" or "transmission idle" in synchronous-type transmission.
R U	"Are You " station________? Used in transmission inquiry to permit generation of "Answer back" signal by simple means.
WRU	"Who Are You"
MTR. STP.	"Motor Stop" for control of remote terminal devices.
V. Tab	Vertical Tabular control
H. Tab	Horizontal Tabular control
F. Out	Form "Feed Out" control
Xtr. Str.	"Transmitter Start" control
Bell	Alarm Bell control
R. 1 on	"Receiver 1 On" control
R. 1. off.	"Receiver 1 Off" control
R. 2. off.	"Receiver 2 Off" control
R. 2 on	"Receiver 2 On" control
8 Data Delimiters	Characters indicating organizational hierarchies of data
L. F.	"Line Feed"
C. R.	"Carriage Return"
U. C.	"Upper Case"

L. C.	"Lower Case"
Ans. Bk.	"Answer Back" or Acknowledgement
Esc.	"Escape" function to be used to indicate Escape to a nonstandard code for one or more following characters
Del.	"Delete" function for erase or "Rub out" purposes.

INFORMATION CHARACTERS

sp	Space or word separator (sometimes called blank in data processing operations)
<	Less than
>	Greater than
←	Is replaced by
↑	Ex ponential
\	Reverse slash; indicates reverse division such as in repeated fractions

???

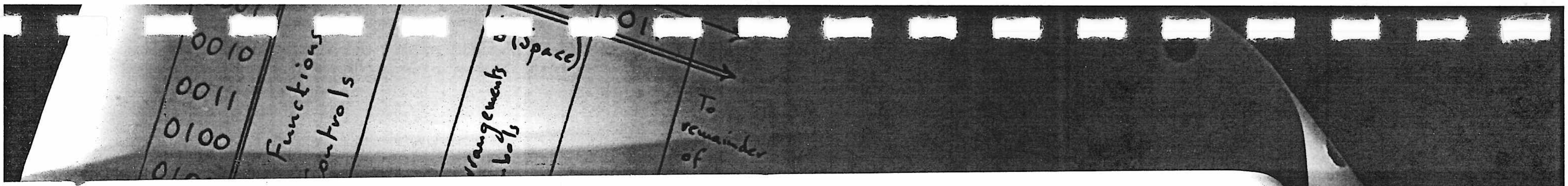
	000	001	010	011	
0000	Basic Functions and Controls		ƀ (Space)	Numbers	To remainder of table
0001			Alternate Arrangements of Special Symbols		
0010					
0011					
0100					
0101					
0110					
0111					
1000	Area of Planned Deviation Supplementary Functions and Controls		Basic Set of Special Symbols		
1001					
1010				Alternate Numbers or Special Symbols	
1011					
1100					
1101				Basic Signs	
1110					
1111					

PROPOSAL TO ATTAIN COMPATIBILITY

		000	
		ƀ (Space) or Null	BASIC FUNCTIONS FOR TYPEWRITER, FLEXOWRITER OR TELETYPE
A	SOM	Spare or CR	
B	M off	Newline or LF	
C	RU	Paperthrow or Vert. Tab	
D	WRU	Horiz. Tab ✓	
E	EOT	Backspace or WRU FF	
F	H Tab	Shift Out or LC	
G	FF	Shift In, Feed Out, UC	
	V Tab	Black or Switch Readers	SUPPLEMENTARY FUNCTIONS ALLOCATED FOR SOME FLEXOWRITERS
		Red or Switch Colours	
		Non Print	
		Print Restore	
		Stop	
		Punch On	
		Punch Off	

H. McG. Ross
26 Oct '61.

NMAH 310/2


0010
0011
0100
Functions
ontrols
(Space)
rangements
bols
To remainder of

	Basic Set		British Currency	British Programming Schemes		1401 7070 Cobol		Bemer 18·9·61		Teletype Keyboard 2·10·61		Algol			
	010	011	011	010	011	010	011	010	011	010	011	010	011	110	111
0000				'		'		'		'					!
0001				[		⌑		"		"		[			{ or "
0010				]								]			} or "
0011				<		<		<		<		<			≤
0100				>		>		>		>		>			≥
0101				=		=		=		=		=			≠
0110				—								—			≡
0111				|								|			÷
1000	(														×
1001	)														←
1010			10		α		%		%		%			$_{10}$	↑
1011	£		11	π	β		$		$		$			:=	
1100			½		½		;		;		;		;	⊃	
1101	&	+												∧	
1110	*	−												¬	
1111	/	.												∨	
Others				: ?	,	: #	,	: # ← ↑	, ! ≤ ≥	: ?	,	:	,		

SUGGESTED ALTERNATE ARRANGEMENTS FOR SPECIAL SYMBOLS

Each Special Set also uses the Basic Set

H. McG. Ross
26. Oct '61

TELEGRAMS
DIGIT, WESDO
LONDON

TELEPHONE
LANGHAM 9211

FERRANTI LTD
ELECTRICAL & GENERAL ENGINEERS

21 PORTLAND PLACE
LONDON W·1

HEAD OFFICE & WORKS
HOLLINWOOD, LANCS
TELEGRAMS
FERRANTI, HOLLINWOOD
TELEPHONE
FAILSWORTH 2000

YOUR REF.

OUR REF. 441/McGR/PJ

31st October, 1961

J.F. Auwaeter, Esq.,
Director of Product Development,
Teletype Corporation, Inc.,
Skokie,
Illinois,
CHICAGO, U.S.A.

Dear Mr. Auwaeter,

I recently had the opportunity to meet in Geneva Dr. W. Kaiser of Standard Elektric, Lorenz, and he was kind enough to mention in general terms the position which has been reached in America in connection with expanded codes and alphabets. I had also heard something of this from my friend, Bob Bemer.

It is very encouraging that the work in America is so nearly compatible with that we have been doing in this country which has now reached the stage of being formally approved as a British Standard. I have written to Bob Bemer making some suggestions which I hope will bring compatibility even nearer, and I feel you may like to see a copy of the relevant notes.

My main suggestion is that the more important functions and controls should be grouped together in the top half of the left-hand or 000 "stick" of the Code Table. Then, when the 7-unit code is collapsed into the 6-unit form, these will appear in the position which we consider to be important.

Secondly, we recognise that these basic functions and controls will each have a variety of different but related meanings in different machines and systems. My chart shows, for example, the correspondence between typewriter and teletype functions.

The lower half of the 000 "stick" would be available for supplementary functions and controls as an "Area of Planned Deviation".

A consequence of this is that those special symbols which are commonly used in many applications should be excluded from the top half of the 010 stick, this space being reserved for the special symbols which are

Contd/.....

NMAHT 310/2

only used in certain systems or which differ from one customer to another. In practice, this only involves some restriction in following rigorously any one established typewriter keyboard, and the more-important symbols & and $ should not be "paired up" with the numbers along the top row of the keyboard.

If you could meet us on this point, there only remains the allocation of codes to the other special symbols and their pairing up on the keys of the keyboard. I believe there is plenty of opportunity for negotiation here, and I am hopeful that any variations or changes required would be very minor and not involve anything serious to the design of machines.

I hope these suggestions may be of value in our common endeavour,

and remain, Yours sincerely,

H. McG. Ross

H. McG. Ross

Standards

H. S. BRIGHT, EDITOR

EDITOR'S NOTE

The following communication has been received from Mr. C. E. Macon, Secretary, ASA Subcommittee X3-2 (Coded Character Sets and Input/Output Media).—H.S.B.

* * * * *

A paper entitled "Design of an Improved Transmission/Data Processing Code" by R. W. Bemer, H. J. Smith and F. A. Williams, Jr. appeared in *Communications of the ACM*, Volume 4, Number 5, May 1961. This paper, along with the Editor's Note, was discussed by the ASA X3-2 Committee at the regular meeting of June 28 and 29. It was the decision of the ASA X3-2 Committee that the following remarks be directed to your attention.

(1) The subject paper was one of a number of such papers by a variety of authors which have been received and discussed by the ASA X3-2 Committee.
(2) The objective of ASA X3-2 is to recommend a *single* coded character set to serve as the standard for *information interchange* between data processing systems and between such systems and associated equipment.
(3) Several man-years of research and study, expended over the past nine calendar months, have brought into being the coded character set currently being considered by ASA X3-2. This set differs considerably from that presented in the subject paper in many highly important points and is by no means a direct outgrowth of the material presented in the subject paper. The points with which the committee is at variance will not be covered in this letter but will be covered implicitly in the documentation supporting the official ASA X3-2 recommendation.

PRACNIQUES (Continued)

TAPE SPLITTING

When information must be written on magnetic tape and then immediately read—as in sorting, or when the information on a magnetic tape must be read several times—as in the manipulation of large matrices, considerable time may be spent waiting for tapes to rewind. Tape splitting eliminates waiting for rewind, at the expense of doubling the number of tape units required. The information formerly written on one reel of tape is now written on two; after half of the information is recorded on one reel, that reel begins rewinding, while the remainder of the information is recorded on a second reel.

This technique has been in use for some time (the author used it in an assembly program early in 1959), but it is not as well known as it should be.

By Donald P. Moore
Western Data Processing Center
University of California, Los Angeles

Algorithms

J. H. WEGSTEIN, Editor

ALGORITHM 70
INTERPOLATION BY AITKEN

Charles J. Mifsud
General Electric Co., Bethesda, Md.

```
procedure  AITKEN (x, f, n, X, F);  real array x, f;
           integer n;  real X, F;
comment  If given $x_0$, $x_1$, . . . $x_n$,  n+1 abscissas and also given
  f($x_0$), f($x_1$), . . . f($x_n$),  n+1 functional values, this procedure
  generates a Lagrange polynomial, F(X) of the nth degree so that
  F($x_i$) = f($x_i$). Hence, for any given value X, a functional value
  F(X) is generated. The procedure is good for either equal or
  unequal intervals of the $x_i$. Aitken's interative scheme is used
  in the generation of F(X). Since the f array is used for tem-
  porary storage, as the calculation proceeds its original values
  are destroyed;
begin integer i, j, t;
  for j := 0 step 1 until n−1 do
    begin t := j+1
      for i := t step 1 until n do
        f[i] := ((X−x [j]) × f [i] − (X−x [i]) × f[j])/
                (x[i] −x[j])     end
          F := f [n]
end
```

ALGORITHM 71
PERMUTATION

R. R. Coveyou and J. G. Sullivan
Oak Ridge National Laboratory, Oak Ridge, Tenn.

```
procedure  PERMUTATION (I, P, N);
  value I, N;  integer N;  integer array P;  boolean I;
  comment  This procedure produces all permutations of the
    integers from 0 thru N. Upon entry with I = false the pro-
    cedure initializes itself producing no permutation. Upon each
    successive entry into the procedure with I = true a new
    permutation is stored in P[0] thru P[N]. When the process has
    been exhausted a sentinel is set:
    P[0] : −1,
    N ≥ 0;
  begin
    integer i;  own integer array x[0:N];
    if ¬ I then
    begin for i := 0 step 1 until N−1 do x[i] := 0;  x[N] := −1;
      go to E end;
    for i := N step −1 until 0 do begin if x[i]≠i then go to A;
      x[i] := 0 end;
    P[0] := −1;  go to E;
A:  x[i] := x[i]+1;  P[0] := 0;
    for i := 1 step 1 until N do
      begin P[i] := P[i−x[i]];  P[i−x[i]] := i end;
E:  end PERMUTATION
```

v 4 #11 Nov 1961

Memorandum

HONEYWELL

FOR ALL INTERNAL COMPANY CORRESPONDENCE

81-3388-043

DATE November 3, 1961 **COPIES TO:**

TO R. W. Reach

FROM J. H. Levin

SUBJECT ASA Standard Character Set

Programming Systems has been reviewing the information contained in your memos of September 18th and 26th.

The following comments are offered for your review: dual purpose

1. There does not appear to be an escape character in the 64 bit set. This would be highly desirable as a method of entering into a language character set and as a method of indicating that the character is not identifiable.

2. Programming Systems sees little use for the vertical arrow and the horizontal arrow in data processing. They undoubtedly were included to facilitate the symbology for programming language. The per cent sign and the lozenge are valuable to data processing but do not appear in the character set.

In

JHLevin

J. H. Levin

JHL/psh

CBI 67/1/1

7 November 1961

!

Memo To: Mr. J. E. Bartelt

Subject: X3.2 Code

Four characters of the 4-bit subset have been available to IBM customers for use in ordering keys. They are . , - / . The * is also used and is to be paired (for keyboard convenience) with the +. Of these characters - and / have, according to our surveys, high frequency usage in keys. The usage of * is small and that of . and , are negligible.

The presently agreed code of X3.2 was specifically structured so that - and / were not in the same stick as the decimal digits. I refused to agree upon a code for IBM unless this condition were met. The reason for this is that with the present X3.2 code the numeric stick can be rotated high with a simple EXCLUSIVE OR element and collate for the 6-bit set effectively identical to the present IBM collating sequence (the changed order among the special characters has been shown to have a trivial effect). The six characters which exist in the numeric stick would not be used in keys, nor do they have relevant ordering properties. This was agreed to by J.R. Auwaerter by Teletype, realizing that the normal keyboard arrangement for these keys would have to be reversed or else the shift bit would have to be inverted for these keys only. Apparently this is not too great a hardship.

Howard Smith, meeting with DS and GP, has now proposed a variation which was accepted at the 3 November meeting of the CSTC. I am in agreement with all of these changes except those pertaining to the above situation! . and / are now in the numeric stick and a transformation much fancier than an EXCLUSIVE OR would be required to get a collating sequence suitable to IBM.

I realize that with an 8-bit set (and upper and lower case alphabets) some extra logic is required to effect the collating of somewhere near 256 characters. However, I think it reasonable to demand that the 6-bit set operate very simply. I suspect that GS and DP might not have known what they were agreeing to. I suggest that you do not propose this particular change to X3.2 on 8 November.

RWBemer

R. W. Bemer

RWB/jes
cc: Mr. W. E. Andrus, Jr.
Mr. H. J. Smith, Jr.

NMAH 310/2

Data Processing Group

bema

Business Equipment Manufacturers Association
235 East 42nd Street, New York 17, New York — MUrray Hill 7-5969

ASA SUBCOMMITTEE X3.2 - CHARACTER SETS AND DATA FORMAT

MINUTES

Meeting #11 of November 8-10, 1961
BEMA Office, 235 East 42nd Street, New York, N. Y.

SUMMARY

Efforts were devoted to completing two important objectives at this meeting--(1) finalization of the proposed standard character code for information interchange; and (2) its documentation for X3.2 formal approval and submission to the X3 Sectional Committee prior to adjournment. Both objectives were realized. A code was agreed upon, and it was incorporated into a formal Draft Standard document prepared to ASA format. A written ballot vote was held on this Draft Standard Code with unanimous support from the X3.2 membership involved. The Draft Standard and ballots were then submitted to the X3 Sectional Committee Chairman.

APPENDICES

A. Attendance
B. Proposed Agenda
C. X3.2 Liaison Assignments
D. X3.2 Membership Geography and Proposed Plan for Meeting Locations
E. X3.2 Membership History
F. Sample Ballot used for X3.2 Approval of Draft Standard Code
G. Proposed American Standard Code for Information Interchange

2/10/96
NMAH

G. M. WILSON
FEB 9 1962
ANS'D
REF'D Received 2/9/62

OUTLINE OF X3.2 MEETING AND MINUTES

1.0 ATTENDANCE

2.0 AGENDA

3.0 DOCUMENTS DISTRIBUTED AT THIS MEETING

4.0 X3.2 TECHNICAL WORK

- 4.1 General Remarks
- 4.2 Documentation of the Draft Standard
- 4.3 X3.2 Meeting Locations
- 4.4 November 8, Afternoon and Evening Sessions
  - 4.4.1 Information
  - 4.4.2 Controls and European Compatibility
  - 4.4.3 ASA Draft Standard Format
  - 4.4.4 Report on X3.2 Placement (Mr. Booth)
  - 4.4.5 Report on European Placement (Mr. Auwaerter)
  - 4.4.6 Report on Placement of Data Delimiters (Mr. Smith)
  - 4.4.7 Resolution of X3.2 Character Code
    - 4.4.7.1 Key Top Arrangement and Group Recognition
    - 4.4.7.2 Printer Controls Arrangement
    - 4.4.7.3 Data Delimiters
    - 4.4.7.4 Final Arrangement of Control Codes
    - 4.4.7.5 Escape Philosophy

5.0 SESSION OF NOVEMBER 9, 1961

6.0 SESSION OF FRIDAY, NOVEMBER 10, 1961

- 6.1 Completion of the Code Chart
- 6.2 Approval of the Draft Standard
- 6.3 Miscellaneous Actions

MINUTES OF X3.2 MEETING OF NOVEMBER 8-10, 1961

1.0 ATTENDANCE

Attendance at the various sessions is reported in Appendix A to these minutes. Guests included:

M. Pivovonsky - Monroe Calculating Machine Co.
S. Rubin - Monroe Calculating Machine Co.
J. Bartelt - IBM

Major Leubbert reported he would not be able to attend. Mr. Pivovonsky attended this meeting as an observer, as the initial step to establishing his membership in X3.2.

2.0 AGENDA

A proposed agenda (Appendix B) was distributed for this meeting. The Administrative Business (Agenda item 7.0) was postponed until the last day. X3.2 faced two objectives of prime importance at this meeting: (1) to finalize the proposed code standard; and (2) to draft the documentation for the presentation of the proposed standard to X3. These two items were given precedence over all other considerations. The agenda was adopted with this understanding.

3.0 DOCUMENTS DISTRIBUTED AT THIS MEETING

The following documents were distributed to attenders:

ASA Style Manuals.
Ferranti letter dated October 30, 1961, from McGregor-Ross to Bemer.
X3.2 Character Set Report Appendix #5, #8, #9.
Wusteney and Kaiser letter to Auwaerter dated 10/26/61.
McGregor-Ross letter to Auwaerter dated 10/31/61.

4.0 X3.2 TECHNICAL WORK

Prior to main discussion, the Chair suggested appending the X3.2 Character Code Draft Standard documentation to the June 1961 DOD Conference Report for purposes of distribution to the participants.

In preparation for drafting the documentation of the standard for submission to X3, and ASA, the Chair proposed the following outline:

Frontspiece
ASA Statement
Foreword

Sections:

1. Scope
2. General Principles
    - 2.1 Error correction and detection
    - 2.2 Unassigned Codes
    - 2.3 Collating Sequence
3. Definitions
4. The Coded Character Set

Appendix:

A. Remarks on the code design
    - A.1 Introduction
    - A.2 Plans
    - A.3 Set size
    - A.4 Set structure
    - A.5 Character selection
    - A.6 Character placement

B. Comments on deviations and substitutions
    - B.1 Sets of different size
    - B.2 Character substitution
    - B.3 Principles relating to "escape" or mode shift
    - B.4 Collating sequence

C. Specific criteria

D. Some comparisons with other codes

E. Remarks on transmission

F. Remarks on data manipulation

G. Glossary

It was suggested that the presentation of information in Sections 1, 2, 3, and 4 above should be made in as positive terms as possible.

4.1 General Remarks

Various positions in regard to acceptability of the code structure proposed at the previous X3.2 meeting were first reported and discussed.

In the discussion, concern was expressed over the lack of coordination between the work of X3.2 and X3.3.

The appointment of a liaison man from X3.2 to X3.3 was recommended. To assure that no such assignment had been made in the past, the Secretary, was asked to review past X3.2 minutes to record the current liaison assignments. (Mr. Utman's report on liaison assignments is attached to these minutes as Appendix C). Time did not permit completion of this review or assignment as proposed, at this meeting.

Discussion of 8-bit codes vs. the proposed 7-bit standard resulted in a consensus feeling that the data processing industry does not have sufficient knowledge at this time to do the necessary research to develop a sound 8-bit standard within one-two years, and that a 7-bit standard will meet the needs of today. Various members concurred with this attitude, and it is believed to be the international attitude on 8-bit sets.

The communication industry states that it must build a "pipe line" big enough now to accommodate need for expansion ten years from now.

This was reported to also be the position of some data processing interests, i.e. machines big enough to grow into, yet small enough to grow out of. They are also interested in making the hard business decisions in terms of low-cost, in machines that are produced in large quantities (thousands), and that are code sensitive.

4.2 Documentation of the Draft Standard

X3.2 next directed its attention to planning the preparation of the documentation of the draft standard with the objective of submission to X3 by November 10, 1961. The following procedure was proposed and adopted:

1. Establish the code.
2. Conduct written ballot vote on its acceptability as a draft standard -

   Voting yes, no, or abstain; with reasons presented for the "no" vote, or "abstention."

   Voting will be individual at this stage and not by corporate affiliation.

3. Draft the minutes of this meeting, reporting the discussions on negative or abstaining votes.

The Chair described the sequence of review and acceptance of draft standard proposals as follows:

1. X3.2, by personal or individual vote.
2. X3 Sectional Committee, by association vote.
3. BEMA/DPG Engineering Committee, by company vote.
4. American Standards Association publication, review, approval and adoption.

Immediate plans for implementing the above were then formulated, with the following assignments:

(1) Study group on "information subsets", to be coordinated by Mr. Bonn.
(2) Study group on "escape" philosophy, to be constituted in PM, November 8.
(3) Study group on controls, to be coordinated by Mr. Booth.
(4) The up-dating of visitors to this meeting to be conducted during the lunch break by the Chairman.

The following items were assigned for draft during this meeting:

Appendix B.1 - by Mr. Bloom and group.
Appendix B.3 - by various members.
Appendix B.4 - by various members.
Appendix C - required edit only.

As previously decided, Appendicies D, E, F, and G will not be included in the initial proposal, in support of the draft standard code.

4.3 X3.2 Meeting Locations

As an administrative break in the technical proceedings, brief discussion was held on the question of meeting locations. It was agreed that the length of X3.2 meetings should continue as two days. It was also agreed that we should plan to hold eight or nine meetings a year, beginning in 1962, in the fourth week in January. In order to be fair on the location of X3.2 meetings in relation to the geographical distribution of its membership, the Secretary was asked to develop an analysis of membership and past meeting locations, and a proposed plan for rotating the location of X3.2 meetings. The results of this analysis, and the plan, were not presented at this meeting of X3.2 due to the priority technical business, but a plan was completed, and is presented as Appendix D to these minutes.

4.4 November 8, Afternoon and Evening Sessions

Following the lunch break, the various ad hoc meetings planned as above were held on an informal basis to prepare additional draft material in documentation of the proposed standard.

X3.2 formally reconvened at 2:00 P.M., with the same attendance as in the morning.

4.4.1 Information Subset

The result of the study group on the information subset, coordinated by Mr. Bonn, were reported. A motion was offered and seconded "that X3.2 adopt the assignment of characters in the information subset as proposed". Discussion revealed that collapse of the control "Bell" wipes out the "period". The motion was set aside temporarily in deference to hearing the report on assignment of Controls.

4.4.2 Controls and European Compatibility

Mr. Booth presented a report of the ad hoc group on assignment of controls. Further discussion was delayed on the basis that X3.2 lacks sufficient appreciation of data delimiter requirements. Involved also is the question of the collapse of 7-bit codes into the 6-bit sets used for data-processing. There is also strong European interest in 6-bit codes as follows:

(1) The U.K. already has a standard code proposal through the British Standards Institute procedure to the point of publication, and do not wish to make major changes.

(2) The TELEX Network could eventually be converted to 6-level code (TELEX is customer-owned equipment).

European interests want all important controls in the upper left half of the 000, or first stick, which will enable these eight characters to collapse into the 010, or third stick.

The problem faced by X3.2 was then summarized as one of having to determine the logic (and the cost) to collapse the proposed standard 7-bit character code into one of two 6-bit sets:

(1) A 6-bit set with data delimiters.
(2) A 6-bit set with format controls.

This is complicated by the additional consideration of European vs. U.S. placement of the control functions.

It was also emphasized, that the Department of Defense is getting more concerned every day with international compatibility. If at all possible, the U.S. standard character code should enable communication with European codes. The Chair then assigned members to three ad hoc groups to gather information for the solution of this problem.

European placement statement and rationale - John Auwaerter and group
U.S.A. placement statement and rationale - John Booth and group
Data Delimiter placement statement and rationale - H.J. Smith and group

4.4.3 ASA Draft Standard Format

Vince Grey from the American Standards Association presented information on the format for Draft Standards, and the procedure for review and approval of proposed American Standards. He reviewed the suggested outline for the documentation, and agreed that it follows the basic ASA arrangement. It was suggested that Item 4, presenting the code itself, contain an explanation of the notation used.

Mr. Grey reported that for purposes of distribution X3.2 can typewrite the proposal without concern with the ASA standard type font. It is important to know that you can change the type font of a draft standard after submission, but you must not change the technical content in any way. Mr. Grey suggested that he be given a copy of the complete draft standard documentation after it has been circulated to the X3.2 Sub-committee, to enable his review before it goes any further in the review process.

Working with Mr. Grey, a final format for the draft standard was evolved as follows:

Front page
Policy statement (ASA)
Foreword
Scope
General Principles
Definitions
The Standard Coded Character Set Chart

The above will constitute the draft standard, and supporting information in the form of Appendicies A, B, and C are not considered part of the actual statement of the standard. The question was asked -- What is approved as an American Standard vs. what is approved for publication? Mr. Grey suggested in answer -- that although the entire Appendix must be approved by X3 in addition to the draft standard, it would be possible to submit Appendicies D, E, F, and G later, as a re-issue of the standard.

At the conclusion of Mr. Grey's presentation, the meeting broke up into the three ad hoc groups assigned as above, to reconvene at 4:00 P.M. and report.

4.4.4 Report on X3.2 Placement (Mr. Booth)

With X3.2 back in session at 4:30 P.M., Mr. Booth reported on his ad hoc group recommendations regarding the placement of controls and data delimiters desired by the U.S.A. as shown in Figure #1a, and in the keyboard layout in Figure #1b.

He explained that this character and keyboard arrangement enables the following:

(1) Collapse of the 7-bit set into a 6-bit set with a minimum loss of essential symbols.

(2) Conformation with the European tradition on "Who are you" with the "D" code, and "Bell" with the "J" code.

(3) Keyboard arrangement into three groups for --

Communication - printer and transmission
Auxiliary equipment control
Data delimiters

4.4.5 Report on European Placement (Mr. Auwaerter)

A proposal was described that attempts to accommodate the known European requirements. It was considered unacceptable, however, at the moment. More discussion on the European-U.S.A. positions followed the next report (see 4.5.7 below).

4.4.6 Report on Placement of Data Delimiters (Mr. Smith)

The arrangement illustrated in Figure #2 was proposed by the ad hoc group. A brief discussion ensued on the accommodation of the European position. The ad hoc group on European position concluded that we (USA) have gone a long way toward meeting the requirements of the U.K., and that they should now come part way toward our position. They felt that establishment of an American Standard Code would influence Canada to adopt a similar position. This in total would seem to present an economic pressure of considerable consequence to the U.K. (whose proposed standard is now at the printers).

It was also proposed that the U.S.A. attempt to approve and adopt a code position which could then be submitted, along with the U.K. standard, to the ISO/TC 97-WGB for resolution at the international level. Regardless, however, X3.2 should first establish the USA standard, which does indeed go a long way toward meeting the U.K. and European requirements.

It was concluded that the U.K. standard stands alone, at this moment without European, and particularly German, support. The U.S.A. must establish a standard as soon as possible, and the proposal of X3.2 to date, as modified at this meeting, is the best available.

4.4.7 Resolution of X3.2 Character Code

At this stage in the deliberations a statement of the agreement and disagreement was attempted, as summarized in Figure #2. The problems remaining included:

Key top arrangement vs. logic for recognizing groups.
Final arrangement of control functions.
Arrangement of printer controls.
Data delimiters.
The escape philosophy, and four high order code positions.

The Chair suggested that as soon as X3.2 establishes agreement on the code, it should break off into Task Groups to draft the various sections of the standards documentation.

4.4.7.1 Key Top Arrangement and Group Recognition

The positions of two sources (A and B) with respect to the controls was reported as shown in Figure #2 (attached). After discussion, and consideration of an additional suggestion by Mr. Bloom, X3.2 accepted the B proposal.

4.4.7.2 Printer Controls Arrangement

A motion was proposed and seconded to arrange the printer controls in the 000, or first stick, high order four positions, as follows: "carriage return," "line feed," "upper case," and "lower case," in ascending binary order. After discussion this arrangement was approved unanimously.

4.4.7.3 Data Delimiters

After brief discussion, the Chair suggested that X3.2 cover the subject of data delimiters in a subsequent appendix to the proposed standard. This was unanimously agreed to.

4.4.7.4 Final Arrangement of Control Codes

Mr. Booth proposed for final consideration the arrangement of the control characters and data delimiters in the first two sticks as shown in Figure #3 (attached). This arrangement was unanimously approved.

4.4.7.5 Escape Philosophy

Arrangement of the four high order characters in the 7-bit code is influenced by two factors: (1) the number of escape codes to be provided, which is dependent on the escape philosophy; and (2) the effect of the collapse of the four high order positions on the special characters in the high order information character (101) stick. It was felt that if X3.2 could untangle these two problems, the character code would be set.

This session adjourned at 7:00 P.M.

The meeting reconvened at 9:00 P.M., and first considered a motion by Mr. Bloom "to approve the arrangement of the high order special symbols in the 101 stick as follows: "at sign," "reverse slant," "left brace," "right brace," "number sign." This motion was unanimously approved.

The desired escape philosophy was then considered at length. Two types of mode change or escape functions were recognized -- a timed mode change to be called "escape," with an automatic return after a set number of character times had passed; and an unlimited mode change with return ordered by encountering a special symbol, to be called "depart".

A straw vote was eventually held, on the question of need of one or two escape control characters. It was concluded from this vote, that X3.2 wants at most a single escape character at this time. The final conclusion was stated as follows:

"Escape" gives a special meaning to only the first character following the escape character. The second and succeeding characters following the escape character, until the next occurrence of "escape", shall be members of the standard set. It is recognized that future applications will require the operation of locking into another mode for a string of characters. The means of performing this operation will be defined at a future date. For immediate purposes, the character code 1111101 shall be reserved for possible future use for this purpose. The arrangement of the four high order character positions in the draft standard code will therefore be as follows:

1111100	Acknowledge
1111101	(Reserve)
1111110	Escape
1111111	Delete

5.0 SESSION OF NOVEMBER 9, 1961

Attendance at this session is reported in Appendix A.

The outline arrangement of the draft standard documentation was reviewed and revised.

The Front Page

ASA statement

Foreword

Table of contents

1. Scope
2. Remarks
    - Collating sequence
    - Principles relating to the code
    - Error detection and control
    - Unassigned codes
    - Delimiters
3. Definitions
4. Coded character set

Appendix:

A Remarks on code design
- A.1 Introduction
- A.2 Plans
- A.3 Set size
- A.4 Set structure
- A.5 Character Selection
- A.6 Character placement
- A.7 Error detection and control

B. Comments on Related sets and substitutions
- B.1 Sets of different size
- B.2 Character substitution

C. Specific Criteria

For later inclusion --

D. Remarks on data transmission

E. Remarks on data manipulation

F. Glossary

Preparation of everything in the above outline down to Appendix A was assigned to an ad hoc group of Macon, Auwaerter, Bonn, Spielman, and Utman. Appendix A and its various subsections was the responsibility . . of the ad hoc group of Griffin, Pivovonsky, Reach, and Whitman. Appendix B and its subsections was the responsibility of Booth, Bloom, H.J. Smith, and Bartelt. The formal session adjourned at 10:35 A.M., to spend the rest of the day and evening in preparation of acceptable drafts as assigned above. The evening session adjourned at midnight.

6.0 SESSION OF FRIDAY, NOVEMBER 10, 1961

6.1 Completion of the Code Chart

Friday morning was spent in ad hoc group continuation of preparations of the documentation of the draft standard under the assignments of the previous day.

The final formal session of X3.2 convened at 1:30 P.M., with attendance shown in Appendix A.

Mr. Booth asked that his motion of the November 8 afternoon session, which proposed a final arrangement of the characters in the first two, or low order, sticks of the 7-bit code, and which had been unanimously approved, now be withdrawn in favor of an "important rearrangement". Whereas this previous motion had placed the order of the control characters in the middle of the first stick as --"end of transmission," "vertical tab," "horizontal tab," "form feed,"---, the communicators now proposed the arrangement by --- "end of transmission," "horizontal tab," "form feed," "vertical tab,"---. This revision was placed in the form of a motion, seconded, and given unanimous X3.2 approval.

A motion was seconded to title the draft standard "Proposed American Standard Code for Information Interchange".. This title was unanimously approved. It is, therefore, the proper phraseology to be used wherever appropriate until approval by the ASA, at which time the word "Proposed" will be removed from the title.

A motion was presented by Mr. Griffin for final resolution of the arrangement of characters in the high order two sticks (110 and 111) - "that the 7th stick, and upper 3/4 of the 8th stick, be noted as unassigned codes, and that the higher order four codes in the 8th stick be arranged as 'acknowledge', (reserved), 'escape' and 'delete'. This section would be called a 'control section'." This motion was seconded, but withdrawn in favor of a superseding motion by Mr. Auwaerter as follows:

> "The first two or low order sticks be titled 'controls', and the middle four sticks title 'graphics'. The 110 stick, and upper 3/4 of the 111 stick, would be 'unassigned codes', and the high order four positions would be title 'unassigned controls'." This motion was seconded and approved, but the vote was not unanimous in its favor.

Mr. Bloom then moved "that the title 'graphics', appear only under the middle four sticks of the information subset, and that the 'unassigned controls' be identified in the individual code positions by a footnote numbered 1." This motion was seconded and unanimously approved. There followed a motion "to remove all heavy interior lines from the code chart, show the unassigned codes with just the number 1, and put the letters DD in the eight data delimiter code positions." This motion was seconded and approved, though not unanimously. This concluded the motions on internal chartsmanship.

Then concerning the binary position notation convention, a motion was presented that X3.2 "adopt the same notation of B0 ---, B6 as favored by the Department of Defense". This motion was seconded, and then discussed at length. This pointed out that at least four conventions for notation exist:

DOD convention - 0---(N-1)

British convention - 1--- N

Communicators convention - 1--- N, and 0 ---(N-1)

Data-Processing convention - 0---(N-1)

It was emphasized that when X3.2 approves a particular binary notation rule it will be establishing tape track numbering conventions as well. Therefore, X3.2 will be establishing a convention for serial transmission, perforated paper tape track numbering, and magnetic tape track numbering, whether it likes it or not. It was also pointed out that the Electronic Industries Association has mixed feelings on binary notation conventions (therefore, no position). The final vote indicated 11 in favor of the convention of B1, ---, B7, with two abstentions and no negative votes. This, therefore, will be the notation convention for the draft standard code chart.

6.2 Approval of the Draft Standard

By the end of this session the documentation of the Draft Standard was completed (Appendix G), to include a Title Page, Foreward, Table of Contents, Scope, Code Chart (Table #1), Notation, Remarks, and Legend. A written ballot vote was held on the acceptability of the statement as a Draft Standard, with unanimous approval of members or alternates attending. The document (Appendix G) was then to be mailed to absent members for their mail ballot vote. All votes and the document (Appendix G) dated November 10,1961 were to be submitted by mail to X3 for consideration as on American Standard.

6.3 Miscellaneous Actions

Prior to adjournment, Mr. Leon Bloom was approved unanimously as the X3.2 representative to the X3 - International Advisory Committee.

The dates of the next X3.2 meeting were approved as January 10-11, 1962 with the location in California.

The meeting adjourned at 4:00 P.M.

Respectfully submitted,

R. E. Utman /s/
Sectetary

mw
Dated: 1/10/62

	000	001	010	011	100	010	110	111
0000	NULL	TON	ƀ	0	!	P		
0001	SOM	R1ON	!	1	A	Q		
0010	FF	R2ON	"	2	B	R		
0011	BELL	EOA	<	3	C	S		
0100	WRU	TOFF	>	4	D	T		
0101		R1OFF	$	5	E	U		
0110	VT	RU	%	6	F	V		
0111	HT	R2OFF	&	7	G	W		
1000		EOT	(	8	H	X		
1001		MOFF	)	9	I	Y		
1010		EOM	.	↑	J	Z		
1011			,	←	K	#		
1100		UC	*	+	L	◊		RU REPLY
1101		LC	:	;	M	[		
1110		LF	-	=	N	]		ESC
1111		CR	/	?	O	\		DEL

FIGURE #1a - X3.2 PLACEMENT, 11/8/61

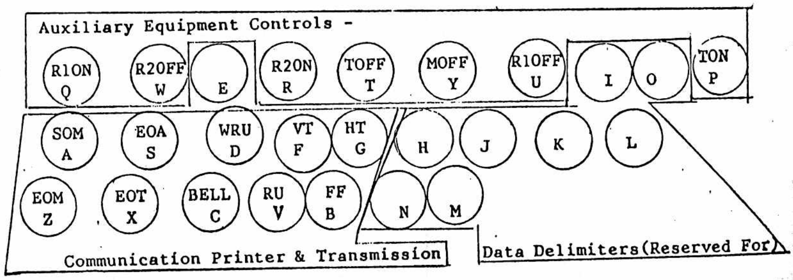


FIGURE #1b - X3.2 KEYBOARD PLACEMENT, 11/8/61

Differences Recommended A(001)	Differences Recommended B(001)	X3.2 (Nov. 8, 1961) 000	001	010	011	100	101	110	111
XOFF	XOFF	NULL	XON	ƀ	0	!	P		
TON	TON	EOA	R1ON	'	1	A	Q		
R1ON	R1ON		R2ON	"	2	B	R		
SOM	SOM	RU	SOM	<	3	C	S		
R1OFF	R1OFF	WRU	TOFF	>	4	D	T		
R2ON	R2OFF	EOT	R1OFF	$	5	E	U		
R2OFF	R2ON	VT	R2OFF	%	6	F-	V		
EOM	EOM	HT	EOM	&	7	G	W		
		FF	DD	(	8	H	X		
			DD	)	9	I	Y		
		BELL	DD	[illegible]	↑	J	Z		Z
		MOFF	DD	,	←	K	#		
		UC	DD	*	+	L	@		RU REPLY
		LC	DD	:	¢	M	[		
		CR	DD	-	=	N	]		ESC
		LF	DD	/	?	O	\		DEL

FIGURE #2 - X3.2 CONSENSUS CODE AS OF Nov. 8, 1961

(Including recommendations A and B)

000	001		
NULL	TOFF		
SOM	TON		
MOFF	R1ON		
RU	EOA		
WRU	R1OFF		
EOT	R2OFF	EOT	E
VTAB	R2ON	HT	F
HTAB	EOM	~~FF~~	G
FF	DD	VT	H
-	DD		
BELL	DD		
-	DD		
CR	DD		
LF	DD		
UC	DD		
LC	DD		

FIGURE #3 Booth Committee Rcommendation of November 8, 1961 on Controls

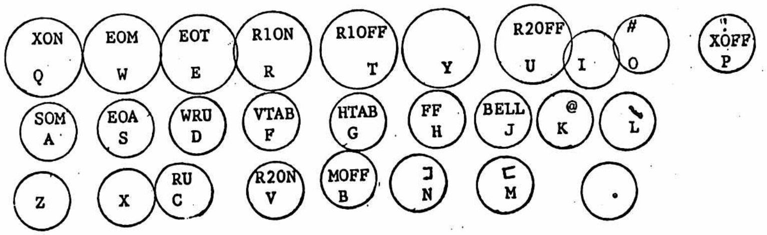


FIGURE #4 - CONSENSUS KEYBOARD ARRANGEMENT , November 9, 1961

APPENDIX A

X3.2 MEETING #11

NOVEMBER 8-10, 1961

ATTENDANCE

Members	Affiliation	November 8	9	10	Alternate	November 8	9	10
J. Auwaerter	Teletype Corp.	x	x	x				
L. Bloom	N.C.R.	x	x	x				
T. H. Bonn	Remington Rand	x	x		R. E. Utman	x	x	x
L. L. Griffin	Navy Dept.	x	x	x				
R. Gryk	AT&T Company				J. B. Booth	x	x	x
H. Kleinberg	RCA				H. Spielman		x	x
W. J. Leubbert	West Point							
C. E. Macon	Burroughs Corp.	x	x	x				
R. W. Reach	Minneapolis-Honeywell	x	x	x				
H. J. Smith, Jr.	IBM	x	x	x				
H. Tholstrup	Friden Inc.			x				
A. L. Whitman	Bell Tele. Lab.	x	x	x				
Guests								
Mark Pivovonsky	Monroe	x	x	x				
Sander Rubin	Monroe	x		x				
J. H. Bartelt	IBM	x	x	x				

APPENDIX C

X3.2 LIAISON ASSIGNMENTS

HISTORY --

A review of the minutes of past X3.2 meetings reveals the following actions occurred on assignment of X3.2 members to liaison responsibilities with other X3 Subcommittees and organizations:

October 4, 1960	Paragraph 2.1 - Mr. Tholstrup agreed to unofficial EIA liaison.
November 9, 1960) December 2, 1960)	Mr. Bonn is informal liaison with X3.4.
Jan. 11-12, 1961	Paragraph 10. - Mr. Tholstrup was appointed by EIA as liaison from EIA to X3.2.
February 14, 1961	Paragraph 3 -- Liaison with X3.3 is to be reported on at the next meeting.
March 8-9, 1961	Paragraph 7. - Acknowledged establishment of Mr. Rossheim (X3.6) as coordinator between X3.2 and X3.6
August 2-4, 1961	Paragraph 5. - Mr. Whitman is appointed liaison with X3.5.
November 8-10, 1961	Mr. Bloom is approved as X3.2 representative to the X3-IAC.

CURRENT LIAISON STATUS --

From the above it is apparent that X3.2 has made only the following official liaison appointments from amongst its own membership:

X3.2 to X3.5 -- Mr. Whitman
X3.2 to X3-IAC - Mr. Bloom

Other organizations have appointed liaison representatives from their membership to X3.2 as follows:

EIA to X3.2 -- Mr. Tholstrup (of EIA)
X3.6 to X3.2 -- Mr. Rossheim (of X3.6)

X3.2 has maintained informal liaison with other groups as follows:

X3.2 to EIA - Mr. Tholstrup (of X3.2)
X3.2 to X3.4 - Mr. Bonn (of X3.2)

ACTION RECOMMENDED --

It is recommended that X3.2 determine its needs for liaison with other organizations, and if justified appoint X3.2 members to liaison representative responsibilities to the following:

X3.2 to X3.1
X3.2 to X3.3
X3.2 to X3.4
X3.2 to X3.6
X3.2 to TR 27.3
X3.2 to C.C.I.T.T.
X3.2 to X6

All X3.2 representatives should receive minutes of the organizations they are assigned to conduct liaison with, attend their meetings as often as possible, and submit brief summary reports of progress and activity in writing (for the X3.2 minutes) and orally at each X3.2 meeting. It is understood that the X3.2 Chairman represents the X3.2 liaison agency with BEMA/DPG and the ASA X3 Sectional Committee, and assumes responsibility for communicating information from these sources to X3.2.

Respectfully submitted

R. E. Utman
X3.2 Secretary

mw
Dated: 11/8/61